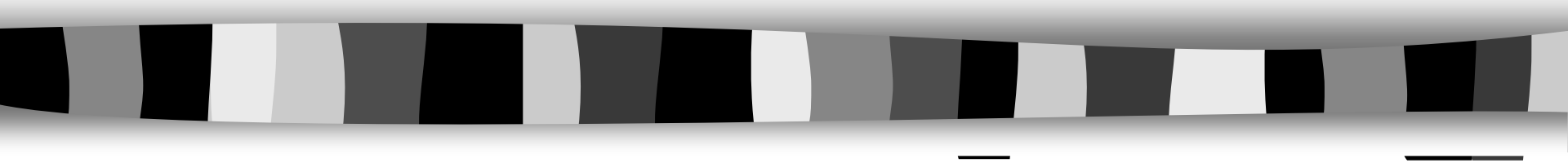
Transfusion Reactions



Directed by M-azad

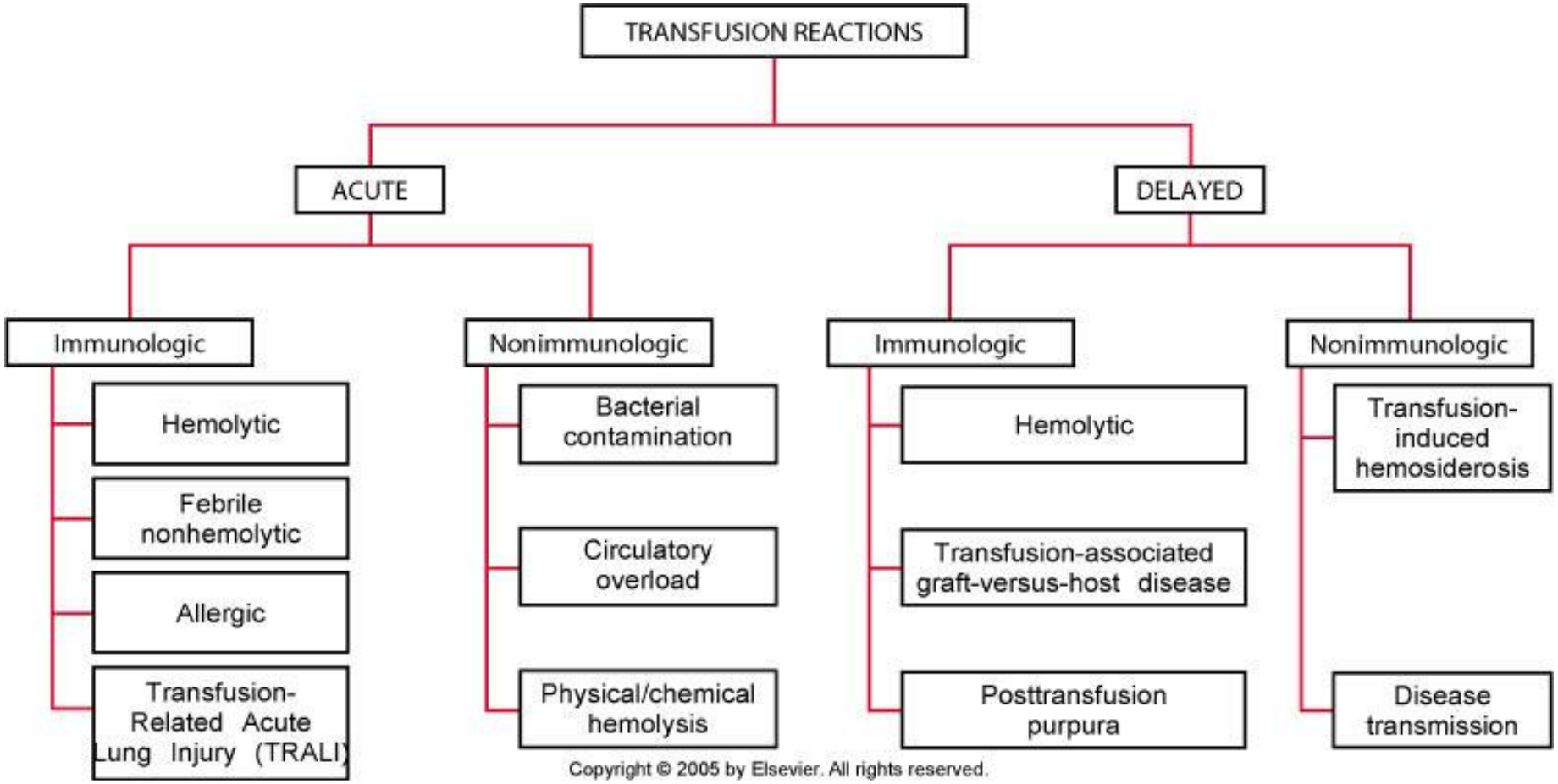
March 2012

Transfusion Reactions are…

Adverse reactions associated with the transfusion of blood and its components

Transfusion reactions

- Non-threatening to fatal
- Hemolytic or non-hemolytic – may or may not cause RBC destruction
- **Acute to delayed**
  - Acute – rapid onset
  - Delayed – days to weeks
- Reactions may involve antigen-antibody interactions
- May involve infectious agents



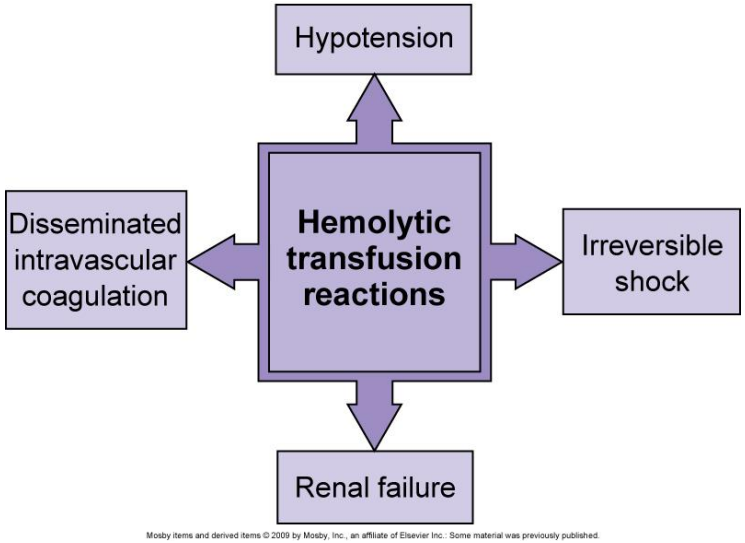
Acute Immunologic Reactions

Hemolytic Transfusion Reactions (HTR)

- Most common cause is ABO incompatibility (clerical error)
- Red cell destruction due to complement activation by IgM (within 24 hours)
- As little as 10-15 mL can trigger a reaction

Symptoms

- **Fever**
- Chills
- Acute renal failure
- Early signs
  - Anxiety
  - Pain at infusion site
  - Back/chest pain



HTR maintenance

- To prevent renal failure, fluids (saline) are infused along with diuretics (furosemide) to increase urine output
- How do you prevent HTR?
  - Follow the standard operating procedures (SOPs) to avoid errors
  - Perform pretransfusion compatibility testing

Febrile Nonhemolytic Reactions

- Caused from HLAs or leukocyte antigens on the WBCs of the donor that react with the recipient antibody (components with WBCs)
- Symptoms:
  - Raises temperature >1°C (**fever**)
  - Chills with fever
  - Shaking
- Antipyretics are used to treat fever or are given as a preventive measure
- Aspirin not used because of its effect on platelet function
- Leukocyte reduced units may also be given

Allergic Transfusion Reactions

- May be caused by antibodies (recipient) to plasma proteins (donor)
- A mild transfusion reaction causes:
  - **Urticarial Reaction**: hives, itching
    - **Erythema**: redness of the skin
    - **Dyspnea**: shortness of breath
- An antihistamine can be given prior to transfusion or during transfusion
- Not life threatening

Anaphylactic Reactions

- May be associated with IgA antibodies
- Very severe & life threatening allergic reaction although rare
- Symptoms:
  - **NO fever**
  - Skin flushing
  - Nausea
  - Diarrhea
  - Hypotension
  - Cardiac arrhythmia
  - Cardiac arrest
  - Laryngeal edema
- Treated with **epinephrine** (vasoconstrictor & bronchiole dilator)

Transfusion Related Lung Injury

- TRALI
- Caused by donor antibodies that react with the recipient's granulocytes or vice versa
- The lungs fill with a high-protein fluid
- Patient displays **acute respiratory insufficiency** with x-ray showing bilateral symmetric **pulmonary edema**
- Dyspnea, cyanosis, tachycardia, and **hypoxemia**

TRALI

- 1 in 5,000 transfusions
- Symptoms occur within 2 hours and may end in 2-4 days if treated
- Treated with IV steroids, although they may not work well
- Prevention:
  - Avoid donations from multiparous women and those who have received multiple transfusions

Acute Non-immunologic Reactions

Bacterial Contamination

- Does *not* involve antigen-antibody interactions
- Results from bacterial contamination of blood products
  - *Yersinia enterocolitica*
  - *Serratia liquifaciens*
- Symptoms appear rapidly:
  - include fever, shock, & renal dysfunction (due to endotoxins), nausea, vomiting
- Stop immediately and treat with antibiotics
  - Hypotension can be treated with vasopressors

Circulatory Overload

- Occurs when a patient is transfused too rapidly, overloading the cardiopulmonary system (too much fluid at one time)
- Symptoms
  - Cyanosis
  - Dyspnea
  - Severe headache
  - Congestive Heart Failure (CHF)
- Place patient in upright position
- Give patients small aliquots of each unit over time to prevent reaction

Delayed Immunologic Reactions

Delayed Hemolytic Transfusion Reactions

- DHTRs occur at least 24 hrs after transfusion
- Mediated by IgG antibodies
  - Patient previously exposed to RBC antigen and has low antibody titer until exposed again
  - Rh, **Kidd**, Duffy, and **Kell**
- DAT negative at first, but becomes +
- Elutions are performed to identify Ab

DHTRs

- Symptoms include:
  - Fever
  - Gradual ↓ Hemoglobin
  - Fever
  - Jaundice
  - Hemoglobinuria
- Must give antigen negative blood

Graft-versus-Host Disease (Transfusion Related)

- Rare but fatal condition that has a 90% mortality rate
- Symptoms appear after about 12 days
- May be caused by donor lymphocytes transfused into an immunocompromised recipient
- **Pancytopenia** occurs as a result of the immunologic response
- Any components that contain T-lymphocytes should be irradiated to prevent GVHD

Posttransfusion Purpura

- Alloantibody directed against a high-incidence platelet antigen ($P1^{A1}$)
- Usually occurs in multiparous women who do not have the antigen
- About 5-10 days after being transfused with platelets, the platelet count drops <10,000/μL
- Cerebral hemorrhage is a major concern
- Possibly treat with corticosteroids or intravenous immunoglobulin therapy (IVIG)

Delayed Non-immunologic Reactions

Transfusion-Induced Hemosiderosis

- Occurs in individuals who receive multiple transfusions
- Excess iron accumulates in macrophages in various tissues (liver, heart, endocrine glands)
- It appears as dark brown granules in the cells
- May lead to organ failure
- Iron chelation therapy may help

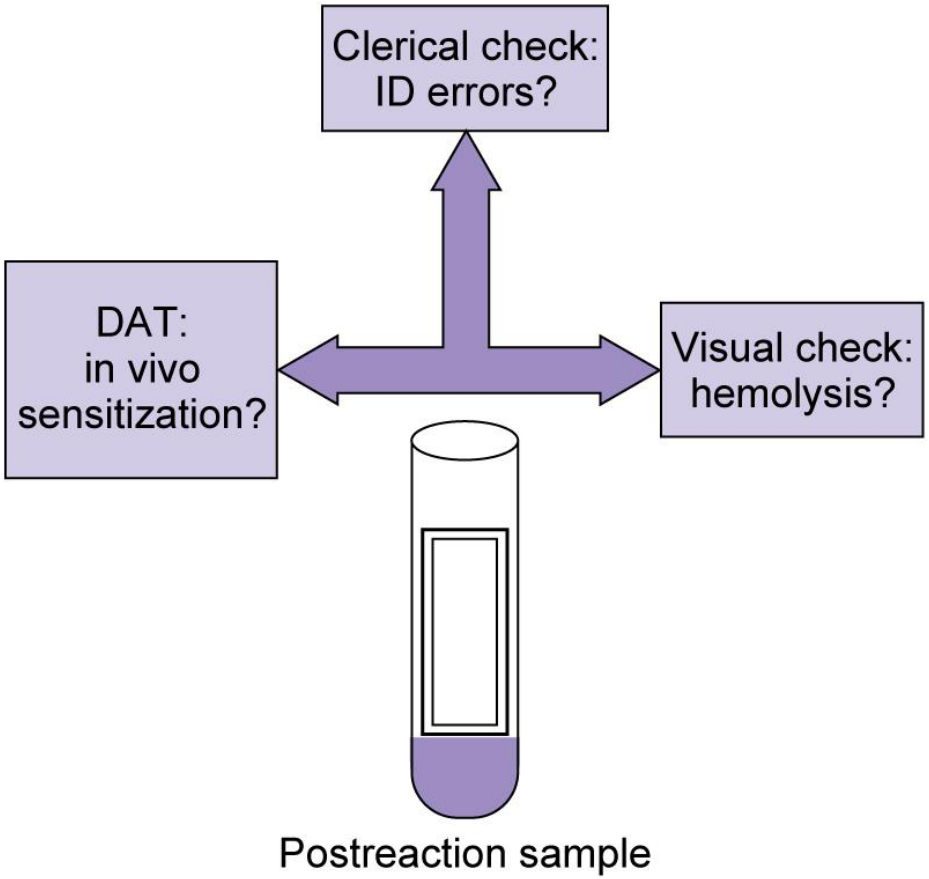
Disease Transmission

- Hepatitis
- HIV
- HTLV
- Cytomegalovirus
- Malaria
- Babesiosis
- Syphilis

Investigating a Transfusion Reaction

What should the medical team do?

- Stop the transfusion immediately
- Saline is maintained in the IV line
- Physicians are notified
- Blood samples are sent to the lab only in cases of:
  - Acute HTR
  - Anaphylaxis
  - TRALI
  - Bacterial contamination



Other Tests

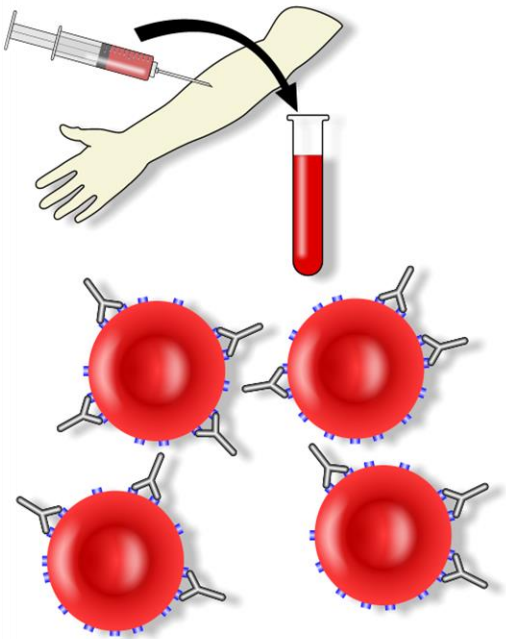
- Haptoglobin, bilirubin, and urine hemoglobin may indicate a hemolytic process
- ABO/Rh typing is performed to rule-out a clerical error
- Antibody screen is used to detect any new antibodies
- Crossmatch will verify serological compatibility

COOMBS TEST

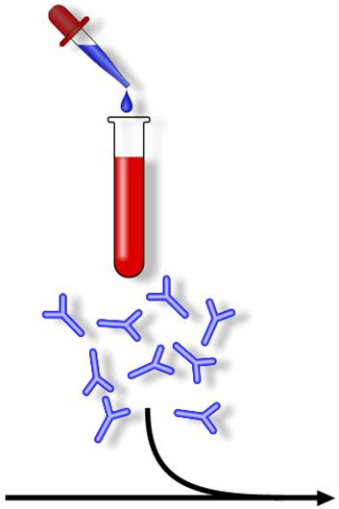
Direct Coombs test (direct antiglobulin test)

- This test is performed to detect anti-D antibody or other antibodies attached to the red cell surface within the blood stream.
- This occurs in the following circumstances:
  - HDN
  - Transfusion reactions
  - Drug induced red cells sensitization
  - Autoimmune hemolytic anemia

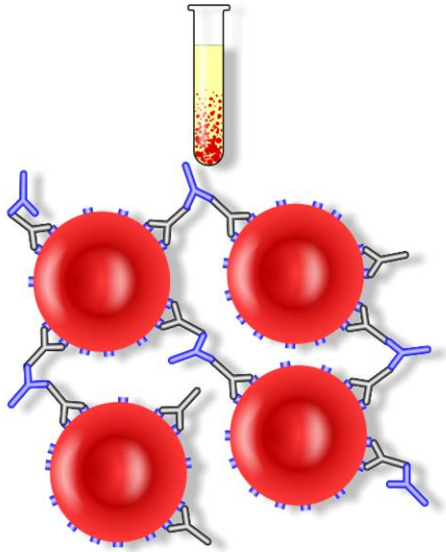
Direct Coombs test / Direct antiglobulin test



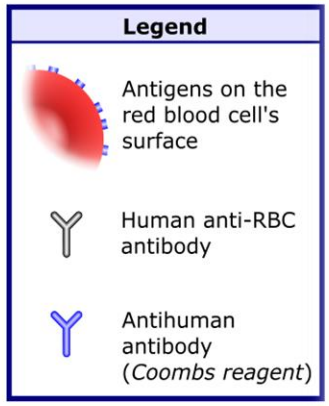
Blood sample from a patient with immune mediated haemolytic anaemia: antibodies are shown attached to antigens on the RBC surface.



The patient's washed RBCs are incubated with antihuman antibodies (*Coombs reagent*).



RBCs agglutinate: antihuman antibodies form links between RBCs by binding to the human antibodies on the RBCs.



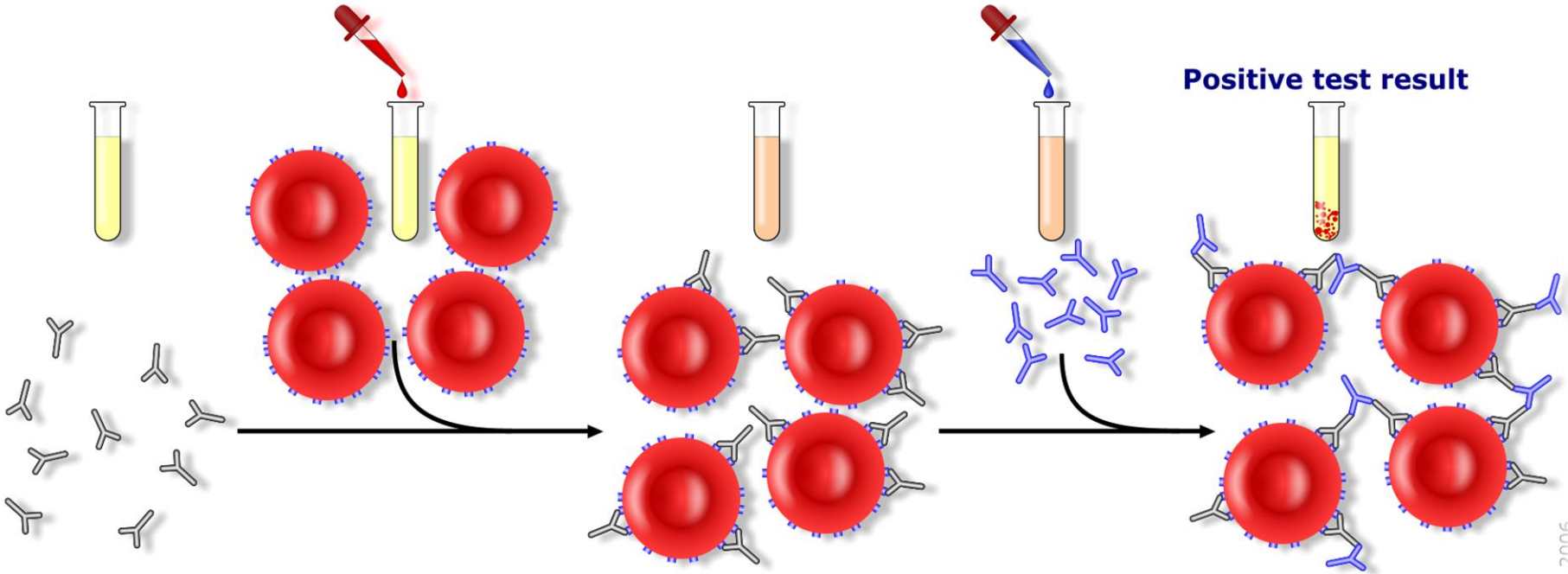
Indirect Coombs test (Indirect Antiglobulin test)

- This test is performed to detect presence of Rh-antibodies or other antibodies in patients serum in case of the following:

1. To check whether an Rh-negative women (married to Rh-positive husband) has developed Anti Rh-antibodies

2. Anti D may be produced in the blood of any Rh-negative person by exposure to D antigen by-
    - **Transfusion of Rh positive blood**
    - **Pregnancy, if infant is Rh positive (if father is Rh-positive)**
    - **Abortion of Rh-positive fetus.**

Indirect Coombs test / Indirect antiglobulin test



Recipient's serum is obtained, containing antibodies (Ig's).

Donor's blood sample is added to the tube with serum.

Recipient's Ig's that target the donor's red blood cells form antibody-antigen complexes.

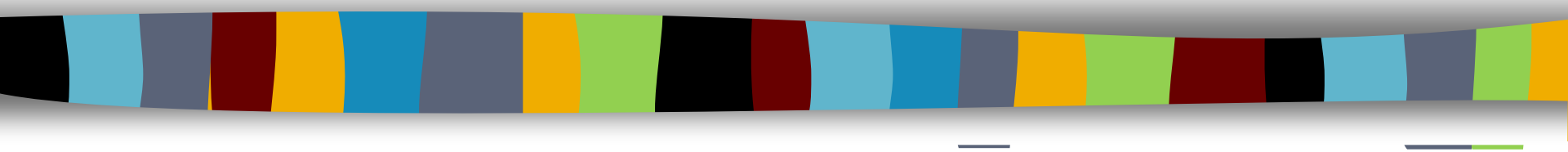
Anti-human Ig's (*Coombs antibodies*) are added to the solution.

Agglutination of red blood cells occurs, because human Ig's are attached to red blood cells.

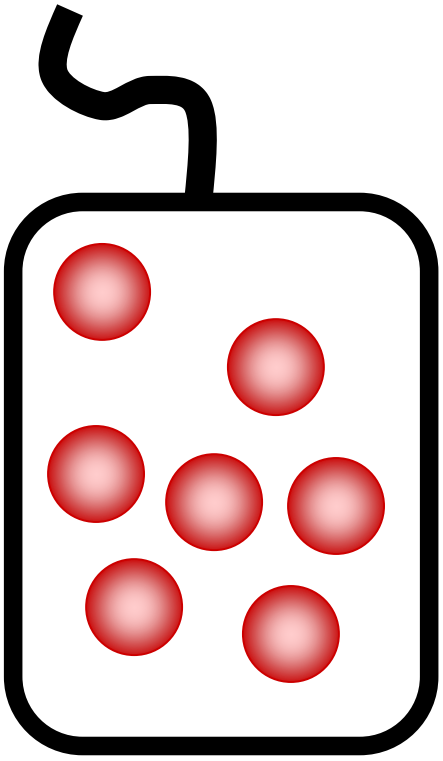
Legend

- Antigens on the red blood cell's surface
- Human anti-RBC antibody
- Antihuman antibody (*Coombs reagent*)

Crossmatch

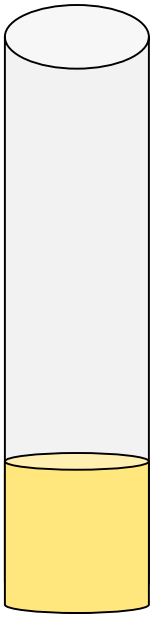


CROSSMATCH



Donor RBCs (washed)

Patient serum

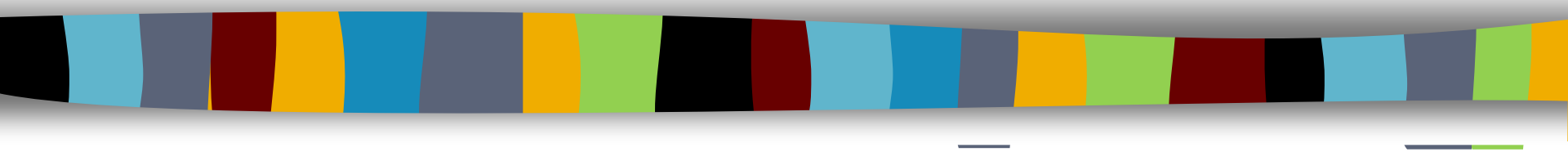


AHG

No agglutination ~ compatible

Agglutination ~ incompatible

Ab Identification

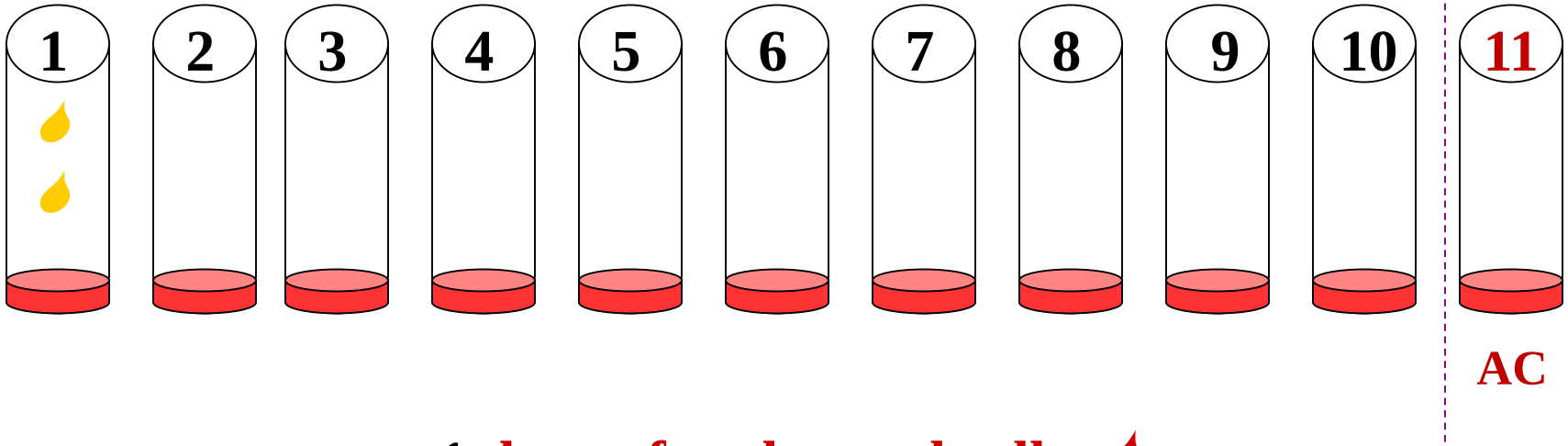


ANTIBODY PANEL VS. SCREEN

- An antibody **panel** is just an extended version of an antibody screen
- The **screen** only uses 2-3 cells

ANTIBODY ID TESTING

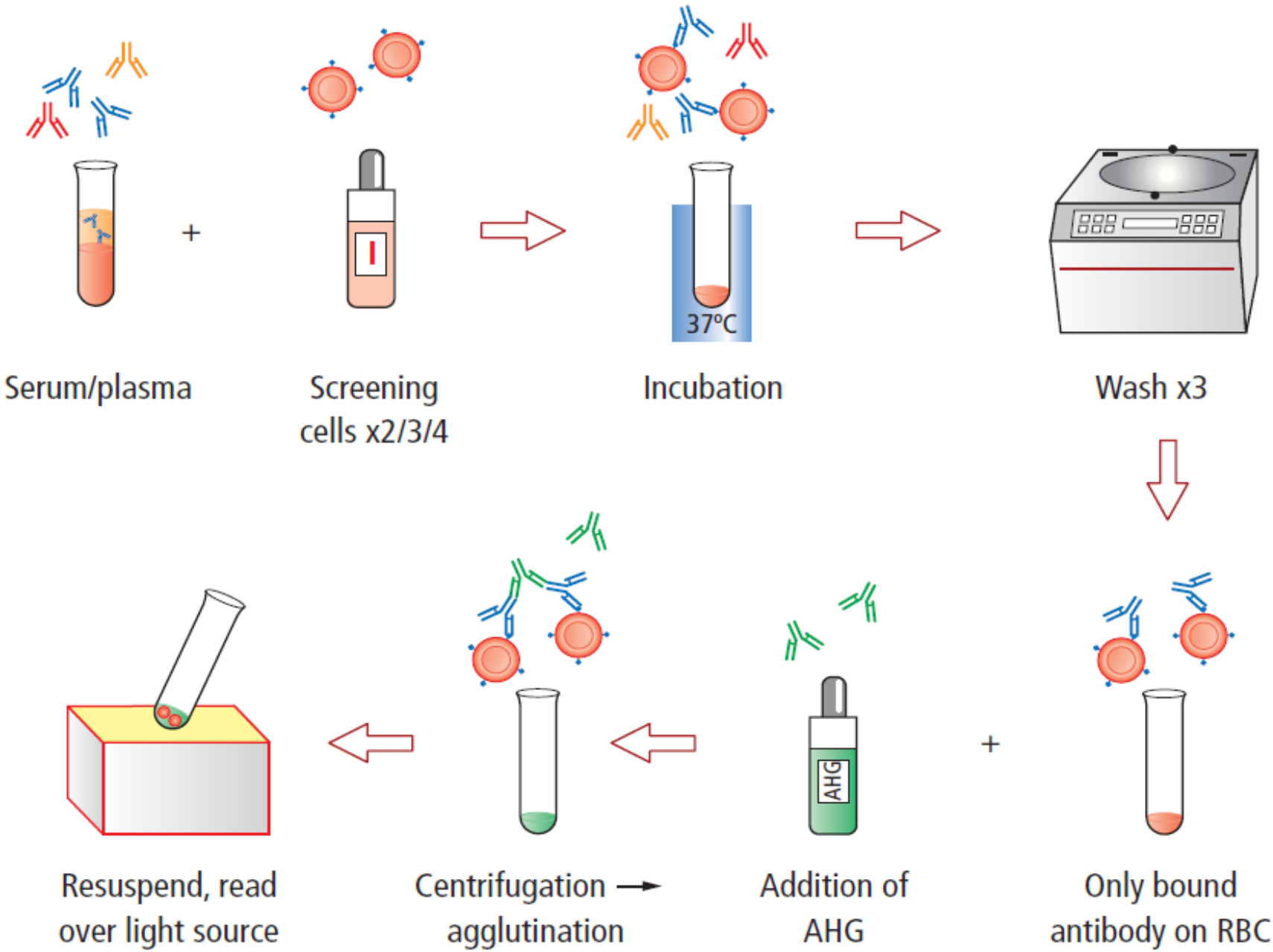
- A tube is labeled for each of the panel cells plus one tube for AC:

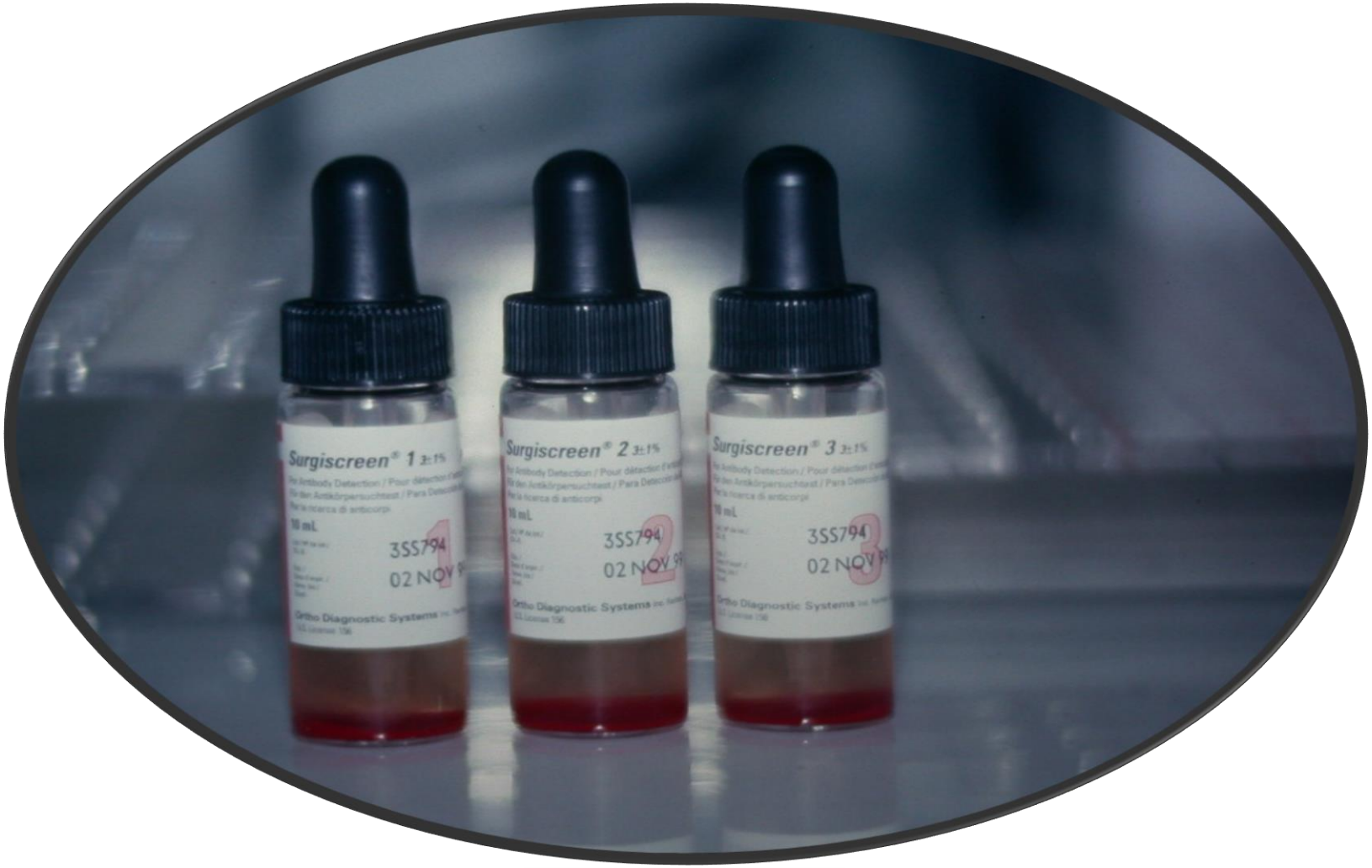


1 drop of each panel cell

+

2 drops of the patients serum


+
37°C
AHG
+
Serum/plasma
Screening cells x2/3/4
Incubation
Wash x3
Only bound antibody on RBC
Addition of AHG
Centrifugation → agglutination
Resuspend, read over light source



	Rh							MNSs				P_1	Lewis		Lutheran		Kell		Duffy		Kidd					
Cell	D	C	E	c	e	f	C^w	M	N	S	s	P_1	Le^a	Le^b	Lu^a	Lu^b	K	k	Fy^a	Fy^b	Jk^a	Jk^b				
I R1R1 (56)	+	+	0	0	+	0	0	+	+	0	+	0	+	0	0	+	+	+	+	0	+	+				
II R2R2 (89)	+	0	+	+	0	0	0	0	+	+	0	+	0	+	0	+	0	+	0	+	+	0				

ANTIBODY PANEL

- An antibody panel usually includes at least 10 panel cells:

↓

Cell Number	D	C	E	c	e	f	M	N	S	s	P1	Lea	Leb	K	k	Fya	Fyb	Jka	Jkb	IS	37	AHG
1	0	+	0	+	+	+	+	+	+	+	+	+	0	0	+	+	+	+	0			
2	+	+	0	0	+	0	+	+	0	+	+	0	+	0	+	0	+	+	0			
3	+	+	0	0	+	0	+	0	+	+	+	0	+	+	+	+	+	0	+			
4	+	0	+	+	0	+	+	+	0	+	+	+	0	0	+	0	+	+	+			
5	0	0	+	+	+	+	0	+	+	0	+	0	+	0	+	0	+	+	+			
6	0	0	0	+	+	+	+	0	0	+	+	0	+	0	+	+	0	+	+			
7	0	0	0	+	+	+	+	+	+	+	+	+	0	0	+	0	+	0	+			
8	0	0	0	+	+	+	+	+	0	+	+	0	0	+	+	0	0	+	0			
9	0	0	0	+	+	+	+	0	+	0	0	+	0	0	+	0	+	+	+			
10	0	0	0	+	+	+	+	0	0	+	0	0	+	0	+	+	0	+	0			
11	0	0	0	+	+	+	0	+	0	+	0	0	+	0	+	+	+	+	+			
Patient Typing																						
INTERPRETATION:																						

	D	C	E	c	e	Cw	M	N	S	s	P1	Lea	Leb	Lua	K	k	Kpa	Jsa	Fya	Fyb	Jka	Jkb	37C	AHG
1 r'r	0	+	0	+	+	0	+	0	0	+	+	0	0	0	0	+	0	0	0	0	+	0	0	0
2 R1R1w	+	+	0	0	+	+	+	+	0	+	+	+	0	0	0	+	0	0	0	+	0	+	0	0
3 R1R1	+	+	0	0	+	0	+	0	0	+	0	0	+	0	0	+	0	0	0	+	+	+	0	0
4 R2R2	+	0	+	+	0	0	+	0	+	0	+	0	+	0	+	+	+	0	+	+	0	+	0	2+
5 r''r	0	0	+	+	+	0	0	+	0	+	0	0	+	0	0	+	0	0	+	+	+	+	0	2+
6 rr	0	0	0	+	+	0	+	0	+	+	+w	0	+	0	0	+	0	0	0	+	+	0	0	0
7 rr, Kpa	0	0	0	+	+	0	+	+	0	+	+	0	0	0	+	0	+	0	+	0	+	+	0	2+
8 rr, Jsa	0	0	0	+	+	0	+	0	0	+	0	+	0	0	0	+	0	+	+	0	+	+	0	2+
9 rr	0	0	0	+	+	0	0	+	0	+	+	0	+	0	0	+	0	0	+	+	0	+	0	2+
10 rr, Lua	0	0	0	+	+	0	+	+	+	0	0	+	0	+	0	+	0	0	0	+	+	0	0	0
Autologous																							0	0


TAKE #1